

# **Army Model & Simulation Office (AMSO)**

## **Benefits Initiative (BI)**

**...helping leaders make better decisions.**

by

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for

## **Summer Computer Simulation Conference, Chicago**





# AMSO BI Purpose

- To **describe** the Benefits Initiative concept.
- To **demonstrate the utility** of the Benefits Initiative process through a proof of principle.



# **AMSO BI**

## **Agenda**

- Background
- Phase I - Concept, Methodology
- Phase II - Proof of Principle



# **AMSO BI**

## ***Examples of Past Work***

- AMSAA's "benefit" Report dated March 1997.
- DMSO's "M&S Benefits Task Force" Report dated December 1995.
- DTSEE "Effectiveness of M&S in Acquisition" dated October 1995.



# AMSO BI

## *Why is the BI Important?*

- A standardized way to quantify M&S benefit is needed to fully justify the expense of M&S.
- The Army must be capable of responding to effectiveness and benefit questions.
- In order to facilitate M&S decisions, a benefits determining process helps make comparisons between alternatives.



# AMSO BI

## ***What are some uses of the Benefits Initiative?***

Multiple HQDA management processes dealing with:

- Vision, strategy and policy evaluation,
  - How significant is M&S to training the Digital force?
- Review, integrate, approve, and prioritize requirements,
  - What should we use? Where should we invest? What has priority?
- Fund activities,
  - What programs could be extended or reduced?
- Reconcile investments,
  - What programs should be eliminated?
- Manage, educate and advocate.
  - Promote understanding through common language and processes.



# AMSO BI BI Charter

## The Army BI Charter Phase I

“...I have directed AMSO to coordinate the Army's efforts to develop and implement a definable process by which quantitative and qualitative M&S benefits are captured enabling our better understanding, justification, and use of M&S across the Army.

“...AMSO will develop a comprehensive M&S benefits methodology (or methodologies) which will provide a factual basis to answer M&S benefits questions.

~~MG LaPorte, ADC SOPS, 23 Jan 98~~

**I** Objectives Hierarchy

**II** Metrics

**III** Techniques to compute benefit  
**Phase**

**IV** Proof of Principle  
**Phase**

**V** Implementation



# AMSO BI

## Phase I Milestones

### Jan 98 Phase I

**Start**

Research & coordinate with domain SME to develop an approach with applicability across all Army Domains.

“**Objective Hierarchy**” -- a “strategy to tasks” tree that captures relationships between tasks & objectives.

“**Metrics Space**” -- a 20 cell matrix that categorizes the full range of metrics used to measure the uses and benefits of M&S.

Populate the Metric Space with metrics.

Glossary of terms that are commonly used, but not generally understood

Sep 98 Phase I Complete

Dec 98 Final Report



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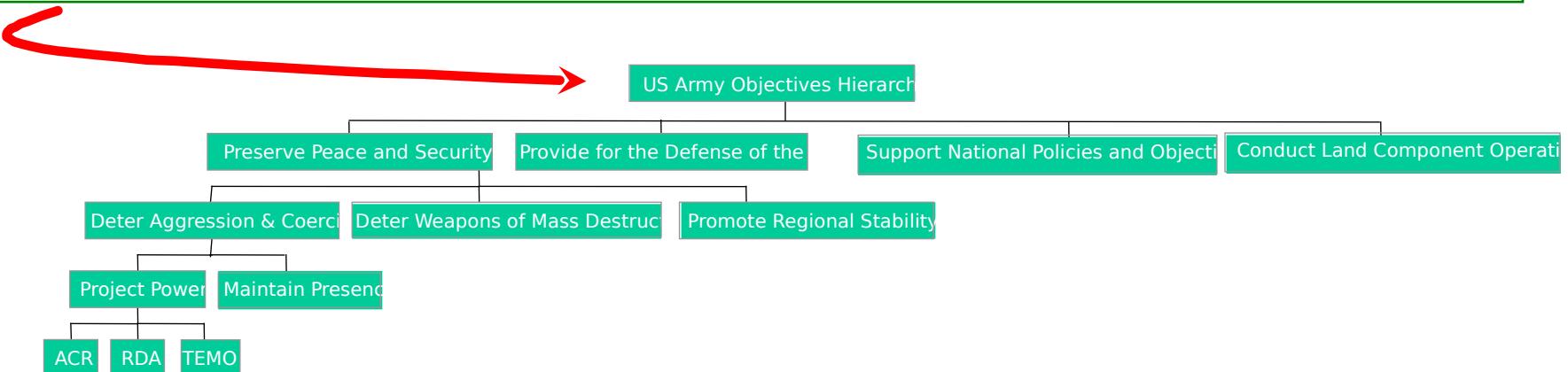
## The Objectives Hierarchy Is...

...An “objectives tree” that decomposes army/domain high-level objectives into lower-level tasks of increasingly more detail.

...Enables “cross-domain” benefit analysis

### The U.S. Army Mission:

- Preserve the peace and security, and provide for the defense of the United States, the Territories, Commonwealths, and Possessions, and any areas occupied by the United States
- Support national policies
- Implement national objectives
- Overcome any nations responsible for aggressive acts that imperil the peace and security of the United States





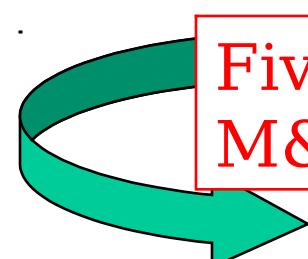
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## The Metric Space Is...

...A two dimensional array for selecting, cataloging and retrieving metrics.

Four basic categories of Benefit

Categories of Benefit



Five basic “uses of M&S”

Uses of M&S

	Communicating	Experimenting	Predicting	Thinking	Training & Instructing
Better					
Cheaper					
Faster					
Only Way					



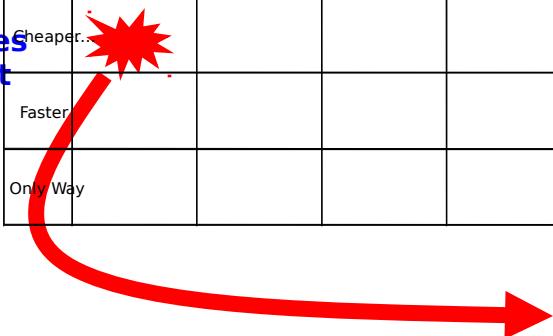
# AMSO BI

## Example: Metrics in the Metric Space

**CHEAPER:** The total cost of the product or process is reduced through the application of M&S.

**AID TO COMMUNICATING:** The use of M&S in helping to visualize concepts, make ideas more comprehensible, illustrate findings, or demonstrate important cause and effect relationships.

		Uses of M&S				
		Communicating	Experimenting	Predicting	Thinking	Training & Instructing
Categories of Benefit	Better	.	.	.	.	.
	Cheaper...	.	.	.	.	.
	Faster	.	.	.	.	.
	Only Way	.	.	.	.	.



Cost savings of using new methods

Cost savings associated with completing task early

Number of dollars saved by using computer models rather than a physical prototype

Money/effort saved in programs that are completed/terminated early

Reduced labor costs due to fewer meetings and data submittals

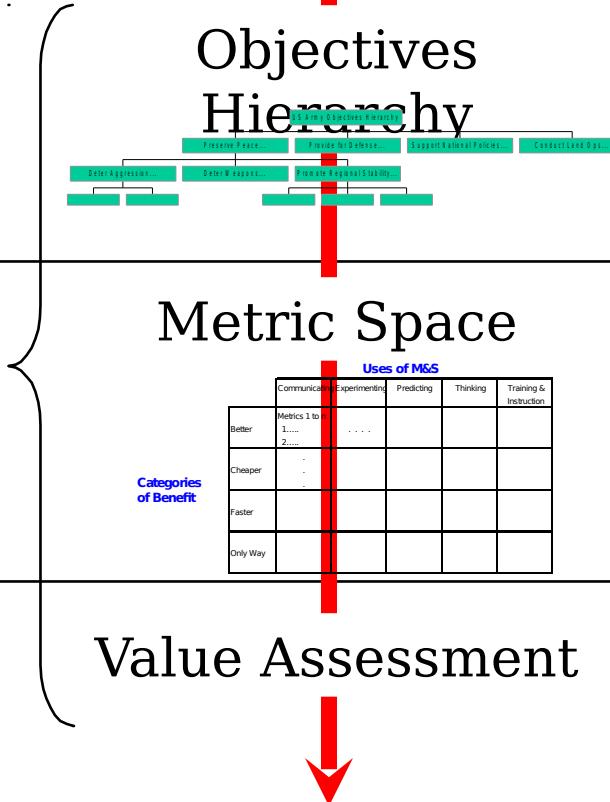
Reduced demand on management, facilities, and personnel resources (i.e. less time, number, amount, etc.)

## How do we get benefit? (Executive Overview)

With  
the  
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too  
l  
s:

We  
derive:

M&S Benefit



The Army's mission is defined in a Hierarchy of Objectives (OH). The contribution of M&S to supporting mission accomplishment is assigned to that location in the OH where M&S is used.

The Metric Space is an organized repository of Metrics. Metrics measure the quantitative outputs and characteristics of the M&S or M&S alternatives, allowing us to determine the “benefit” derived from the output/characteristic.

Measure the value different M&S users assign to the “benefit” obtained from the M&S.

“Value” is assigned to applicable nodes at the lowest level of the OH. “Importance” is assigned to the legs at all levels of the OH. Aggregate “benefit” is assessed up the OH.



# **AMSO BI**

## **Purpose of Phase II**

- To **demonstrate the utility** of the Benefits Initiative through a proof of principle.
  - by employing products and techniques developed in Phase I
  - by executing in a time and dollar constrained environment
- To **provide insight** into a current problem which will be used in a “real world” decision.



# **AMSO BI**

## **Phase II Milestones**

### Sep 98 Phase II

Start

- ★ Phase I Status/Phase II concept Brief
- ★ Phase II Problem Selection Decision Pre-brief
- ★ Phase II Problem Selection Decision
- ★ Proof of Principle concept brief.
- ★ Employment of Benefits Initiative
- ★ Proof of Principle Results Briefing.

Feb 99 Phase II Complete

Apr 99 Final Report



# ***AMSO BI Refined Problem Statement***

**Recommend a simulation/stimulation package to support the Joint Contingency Force Advanced Warfighting Experiment (JCF-AWE).**



# AMSO BI

## Provided Alternatives

- A. **JCATS**: White Cell to drive SOF-HUMINT, Intel Systems, Pol-Mil, SASO and CSS inputs; **JCATS** to drive Joint Air and Naval Forces, USMC Amphibious Operations, the Strike Force, SOF, and Intel Functions.
- B. **JSAF**: White Cell to drive SOF-Humint, Intel Systems, Pol-Mil, SASO and CSS inputs; **JSAF** to drive Joint Air and Naval Forces, USMC Amphibious Operations, the Strike Force, Heavy Forces, SOF, and Intel functions.
- C. **JTC+**: **Spectrum** to drive SOF-Humint, Intel Systems, Pol-Mil, and SASO inputs; **JTC** to drive the Strike Force, Heavy Forces, Joint Air and Naval Forces, USMC Amphibious Operations, SOF, Intel and CSS functions.
- D. **JTC**: White Cell to drive SOF-HUMINT, Intel Systems, Pol-Mil, and SASO inputs; **JTC** to drive the Strike Force, Heavy Forces, Joint Air and Naval Forces, USMC Amphibious Operations, SOF, Intel and CSS functions.

All options include:

- JRTC live environment
- Entity Based Model for 1 INF TF (TF3)
- Live MOUT ACTD for USMC company



# AMSO BI Approach

- Cost benefit
  - Each alternative's benefit measured against a pre-determined set of criteria. Alternatives provided by NSC.
  - Cost benefit calculated by dividing the benefit, for each alternative, by its respective implementation cost. Cost estimates provided by NSC.
- Analytic Hierarchy Process (AHP)
  - Develop and "compare" criteria / Objectives Hierarchy
  - Develop benefit ratings for each alternative



# AMSO BI

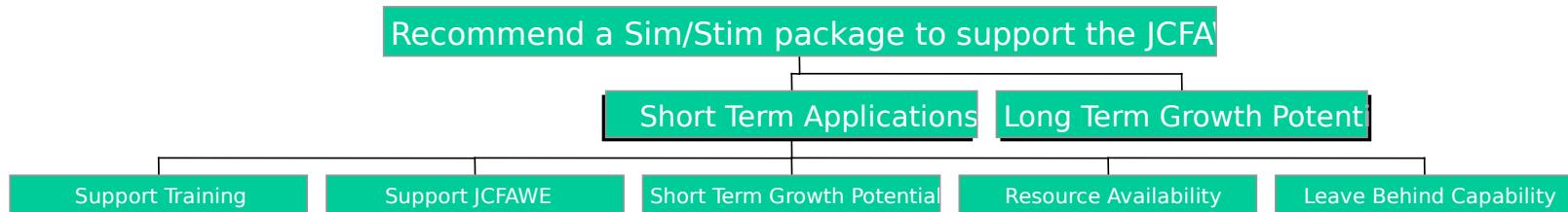
## *Steps to Implement the Approach*

- **Preparation and General Research**
  - Draft Problem Statement
  - Evaluate alternatives
  - Evaluate decision criteria
- **Group Assessment Meeting 1: Structure and Criteria**
  - Finalize the Problem Statement, Decision Criteria, and Alternatives
  - Construct and weight Objectives Hierarchy
- **Specific Research and Impact Analysis**
  - Study relative impact (or performance) of alternatives on each of the relevant criteria (apply metrics)
- **Group Assessment Meeting 2: Assessment of Alternatives**
  - Debate the relative impact or performance of alternatives on the criteria
  - Weight alternatives
- **Analysis Tasks**
  - Analyze participant inputs
  - Conduct Sensitivity Analysis
  - Summarize Findings and Conclusions
  - Identify recommended option and why
- **Group Assessment Meeting 3: Findings, Conclusions, and Recommendations**
- **Report**



# AMSO BI

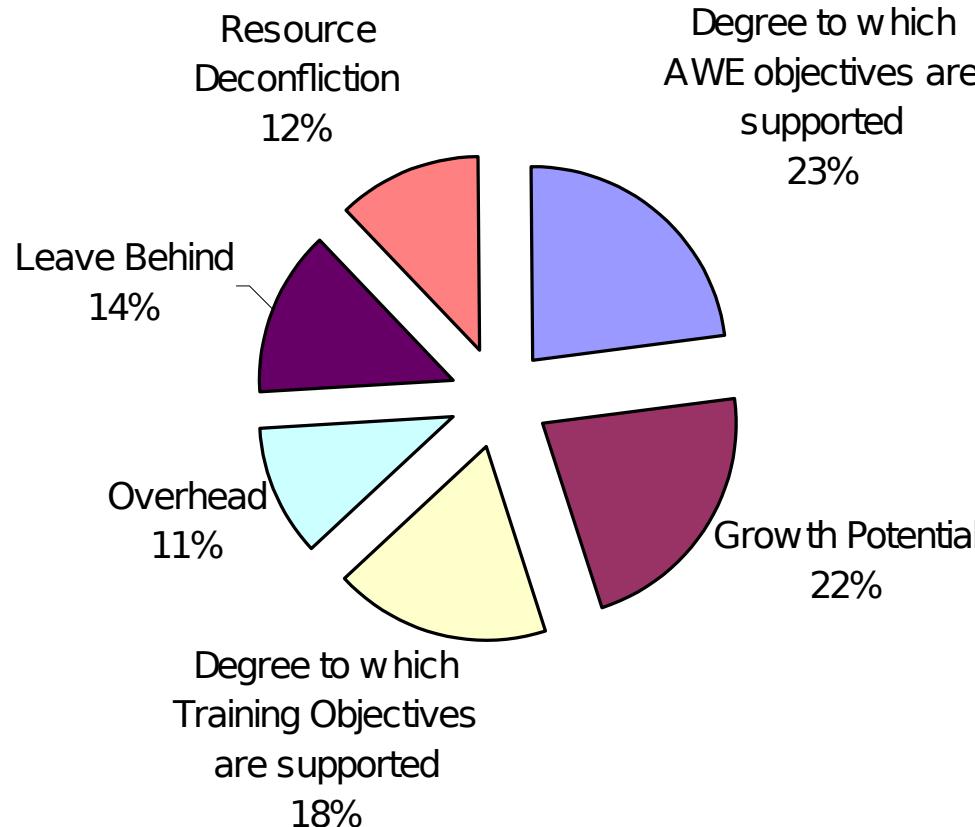
## Objectives Hierarchy (first three levels)



- Objectives Hierarchy structured and weighted by group consensus of Subject Matter Experts (five SME).
- 7 levels with 62 criteria at the bottom nodes.
- Structure of the Objectives Hierarchy shaped by purpose of experiment and planning considerations.

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## Major Selection Criteria



*Cost is treated as an Independent Variable*



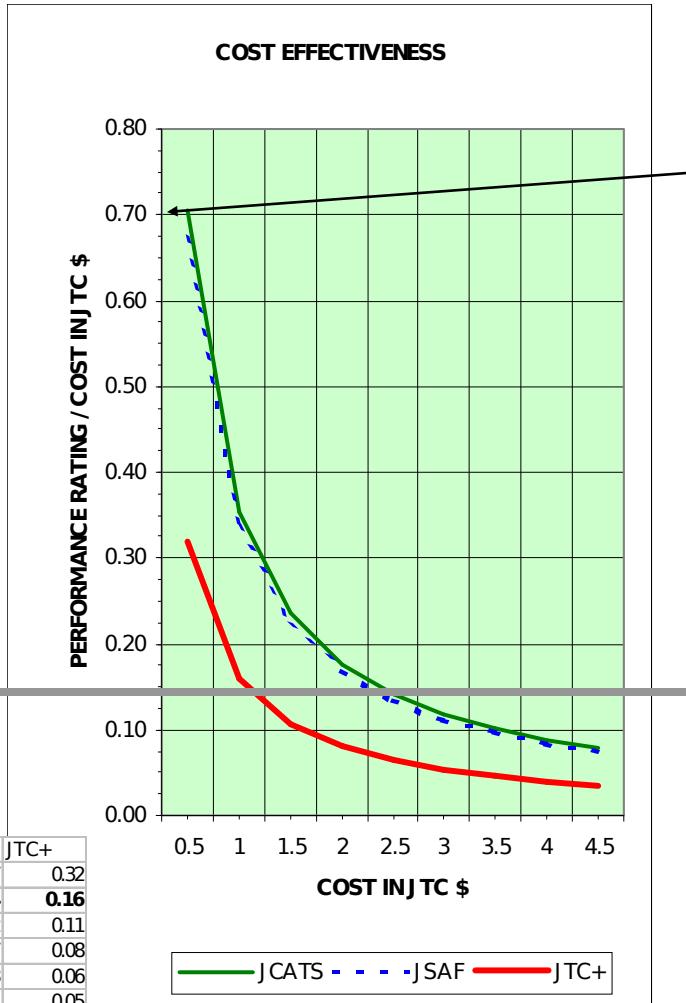
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## Overall Benefit (Higher is Better)

CRITERIA	J CATS	J SAF	J TC+	J TC	CONTRIBUTION
AWE OBJ ECTIVES	6.5	6.6	5.0	5.0	23%
GROWTH POTENTIAL	7.9	10.7	2.0	1.8	22%
TRAINING OBJ ECTIVES	4.0	3.1	5.8	5.0	18%
LEAVE BEHIND	7.2	4.0	1.4	1.4	14%
RESOURCE AVAILABILITY	5.4	5.4	0.6	0.6	12%
OVERHEAD	4.2	3.8	1.2	1.3	11%
PERFORMANCE RATING	35.3	33.6	16.0	15.2	100%

The Baseline is JTC and provides .15 units of benefit for 1 unit of cost

	JCATS	JSAF	JTC+
0.5	0.71	0.67	0.32
<b>1</b>	<b>0.35</b>	<b>0.34</b>	<b>0.16</b>
15	0.24	0.22	0.11
2	0.177	0.17	0.08
25	0.141	0.13	0.06
3	0.12	0.11	0.05
3.5	0.10	0.10	0.05
4	0.09	0.08	0.04
4.5	0.08	0.07	0.04



# AMSO BI

## Cost Effectiveness

- Cost is an Independent Variable
- X axis is cost in JTC \$
- Y axis is cost effectiveness (e.g. JCATS benefit of 35 divided by .5 JTC \$ equals cost benefit of .70)

### OBSERVATIONS:

- JSAF, JCATS, and JTC+ are preferred when their cost effectiveness curves lie above the baseline. JTC is preferred in regions where these curves fall below the baseline
- We prefer JTC+ when its cost in JTC \$ is less than 1.05
- We prefer JCATS over all others when its cost in JTC \$ is less than 2.32
- We prefer JSAF over JCATS when JSAF cost is marginally less (about 4% less) than JCATS

### NSC Cost Estimates (in JTC \$)

JTC = 1

JTC w/Spectrum < 1.1

JCATS = 2.5

JSAF = 4



# **AMSO BI**

## ***Proof Of Principle Recommendation***

- If budget is paramount, then use JTC.
- If benefit is paramount and you can absorb the cost, then use JCATS.
- If long term growth potential is paramount, you can absorb the cost, and risk is acceptable, then use JSAF.



# **AMSO BI**

## **Benefits Initiative Feedback**

- Provides a structured process to get insight, to justify or to debate (Phase II---NSC.).
- “Levels the playing field” and provides standardization. Should be adopted by the Army and possibly DoD (Phase II---NSC.).
- Only on-going effort by a Service. (Phase II---DoD Training Functional Working Group).



# Army Modeling & Simulation Office

## Benefits Initiative (BI)

**...helping leaders make better decisions.**

<http://www.amso.army.mil/>



# AMSO BI

## AWE Considerations

Scope  
Before/During/A  
fter  
Joint/C4IS  
R  
Leave  
Behind

- The JCFAWE focuses on the JTF (corps and below) with JRTC at Ft Polk.
- NSC is tasked to lead the simulation/stimulation effort:
  - train-up support to participating units
  - support the AWE event
  - provide follow-on sustainment training for any residuals.
- The simulation/stimulation package must provide joint operational and tactical context for participating units and to stimulate all their C4ISR.
- In the selection process, consider each simulation/stimulation package's potential to mature into a system that satisfies current and emerging C4ISR training requirements.



# AMSO BI

## Metric Space

- Measures of Effectiveness not used to explicitly measure the alternatives against the criteria.
- The Metric Space provided a backdrop for discussion

The ability to make relative judgements based upon experience is a strength of AHP



# AMSO BI Metrics

		USES				
BENEFITS		Communicating	Experimenting	Predicting	Thinking	Training & Instructing
Better		*	*	*	*	*
Cheaper			*			*
Faster		*	*			*
Only Way		*	*			*



# **AMSO BI**

## **Summary of Findings**

- The older systems (JTC and JTC w/ SPECTRUM) are expected to provide better training for Corps/JTF & Division Staffs.
- JTC is preferred over JTC+ if people/equipment availability in September is an issue (UFL in August 2000).
- The newer systems (JCATS and JSAT) are preferred when overhead, interfaces, and integration with C4ISR are issues.
- JCATS is preferred over JSAT for the near term but JSAT has significantly greater long term potential.
  - JCATS and JSAT are essentially equal over all



# AMSO BI

## *Sensitivity Analysis*

- JCATS and JSAF preference ratings are sensitive to value placed on short term needs versus long term growth potential:
  - An 8% shift favoring the long term results in equivalent performance ratings
  - Cost remains the overriding factor
- JCATS and JTC have roughly equivalent cost effectiveness; a 10% reduction in JCATS implementation cost makes them equivalent
- JSAF requires a 40% reduction in implementation cost to achieve equivalent cost effectiveness with JTC